This chapter investigates domestic sanitation systems. It looks at the many different sanitary appliances available and the systems of above-ground sanitation pipework that they are connected to, which ensure hygienic living conditions in our homes and the surrounding environment.

IN THIS CHAPTER, YOU WILL COVER:

1 Appliances and associated components used in sanitary installation
   1.1 Working principles of different types of toilets
   1.2 Different types of urinal
   1.3 Working principles of an automatic flushing cistern
   1.4 Different types of bidet
   1.5 Different types of wash basin
   1.6 Factors to consider when selecting taps for installing with a bath and basin
   1.7 Different types of sinks
   1.8 Methods of connecting waste fittings to sanitary appliances
   1.9 Alternate means of waste disposal.

2 and 3 Installing sanitary appliances
   2.1 Safe storage methods for sanitary appliances
   2.2 Safe handling of sanitary appliances
   2.3 Different fixing methods required for installing sanitary appliances
   2.4 Installing a sanitary appliance
   2.5 Bespoke tools used for the installation of sanitary appliances
   2.6 Quality checks of sanitary appliances.
SANITARY APPLIANCES

There are two purposes of sanitary appliances: to maintain personal hygiene by washing, bathing or showering, and to remove solid and fluid human waste. During this first part of the chapter we will look at the types of sanitary appliances used in dwellings and their working principles.

MATERIALS USED FOR SANITARY APPLIANCES

The materials used in the manufacture of sanitary appliances are listed in the table below. They must be robust, hygienic and easy to clean.

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Appliances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitreous china</td>
<td>This material is made from white-burning clays and finely grained material mixed with ball clay, a fluxing agent and water into casting clay known as slip. The slip is fired to a high temperature and even in its unglazed state cannot be contaminated by bacteria and remains hygienic in all situations. Glazed vitreous china is stain-proof, burn-proof, rot-proof and non-fading and is resistant to acids and alkalis. Vitreous china is available in many colours and shades.</td>
<td>WC pans and cisterns, Wash basins, Bidets, Urinals</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>This is made from 304- or 316-grade stainless steel to European Standard EN 10088-2. It is usually fitted in areas to which the general public has access and is highly resistant to vandalism. All stainless steel sanitaryware conforms to the Department of Health specification.</td>
<td>WCs and cisterns, Wash basins, Kitchen sinks, Urinals</td>
</tr>
<tr>
<td>Fireclay</td>
<td>Made from buff-coloured ball clays from Devon and Dorset in the UK, fireclay is very robust to withstand rough treatment but, unlike vitreous china, it is porous. Because of this, it requires firing with a ceramic undercoat to seal the clay before being coated with two coats of white glaze, and then re-fired.</td>
<td>Belfast sinks, London sinks, Butler’s sinks, Urinals, Heavy-duty WC pans and wash basins for hospitals</td>
</tr>
<tr>
<td>High-impact plastic</td>
<td>Usually manufactured by injection moulding techniques.</td>
<td>WC seats, WC cisterns, Bath panels</td>
</tr>
<tr>
<td>Acrylic</td>
<td>Sheet with thicknesses varying between 3mm and 8mm is heated until it becomes soft and pliable and is then placed over an aluminium mould where it is sucked into place. This is known as vacuum forming. Acrylic is warm to the touch and can be moulded into many shapes. It is, however, easily damaged by scratching and abrasive cleaners. Acrylic baths are often strengthened by a baseboard made from chipboard and glass-reinforced polyester (GRP). It is very lightweight and appliances are usually aimed at the domestic market. Acrylic baths require a supporting cradle.</td>
<td>Baths, Bath panels, Wash basins, Shower trays</td>
</tr>
</tbody>
</table>
Enamelled cast iron | Cast iron is extremely robust but is very heavy and very cold to the touch. Because of the nature of cast iron, bath designs tend to be very traditional.
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Porcelain enamelled pressed steel | The steel sheet used in the manufacture of sanitaryware must be of the highest grade low carbon steel. The enamel is sprayed on and then kiln fired. It is rigid but light; very robust, but the enamel is easily damaged.
---|---
Baths | Baths
Wash basins | Wash basins

**CONVENTIONAL WCS**
The acronym WC stands for ‘water closet’. It consists of a WC pan and a flushing cistern. There are three types of WC pans:

- **Wash down type** – This is the most common type of WC fitted in the UK. The pan is cleared by a carefully designed water distribution system, which uses the force of the water flush and the volume of water delivered to the bowl to clear the contents. Wash down-type WC pans are usually around 400mm high, depending on the manufacturer, and have 50mm of water seal in the trap. Smaller versions are available for use in infant schools. The bowl is shaped to provide efficient effluent clearance while maintaining easy cleaning.

- **Single-trap siphonic type** – There are two types of siphonic pan but both work in a similar manner: the flushing operation creates a vacuum, which contributes to clearing the pan. The first type is the single-trap siphonic WC pan – this has a lower outlet than other pan designs. It is also known as the Malvern-type WC pan. It is usually only installed as a direct replacement, as the design tends to look very dated. It works by restricting the flow of water from the cistern and this allows a build-up of water in the pan, which is then forced through the restricted neck of the trap, creating a vacuum behind it and clearing the pan contents completely.

- **Double-trap siphonic type** – This type is very rarely sold in the UK because the flushing volume of WC cisterns was reduced to 6 litres by the Water Supply (Water Fittings) Regulations 1999. This kind of WC pan is very quiet and extremely efficient at removing the pan contents. Unlike the single-trap siphonic pan, the double-trap siphonic pan has
an unrestricted outlet and two water traps. A special pressure-reducing valve called an aspirator (or bomb) is fitted to the bottom of the siphon. When the cistern is flushed, a negative pressure is created in the chamber between the two traps by the aspirator. The aspirator is a venturi device, which sucks out the air from the chamber as the water from the flush passes through it. This causes the contents of the bowl by be sucked through the two traps. The aspirator holds a little water back to refill the second trap after the flush is complete. Double-trap siphonic WCs tend to be longer than wash down types because of the extra water trap.

WC styles

WCs can be manufactured in five main styles:

- **Close-coupled** – The WC pan is designed to have the cistern bolted to the back of the pan to form one unit.
- **Low level** – The cistern is connected to the WC pan by a short flush pipe to convey the water from the cistern to the WC pan.

- **High level** – Similar to the low level type but the flush pipe is much longer and the cistern is at high level. Usually used when designing period bathroom suites.

- **Back to wall/concealed** – This style is becoming more popular due to the fact that the cistern is concealed in a cabinet or behind a panel. The WC pan sits close to the cabinet or panel.

- **Wall hung** – This type gives the effect of space, as the WC pan is hung on the wall and is completely free of the floor.

In the past, WC pans were manufactured with a variety of P-trap and S-trap configurations formed as part of the pan casting, but this proved expensive. As a result, today most WC pans are manufactured with the P-trap configuration, but with the use of an angled WC pan connector they can be made into an S-trap or left or right outlet depending on the installation requirements.

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**The WC cistern**

The WC cistern is the method by which the water is discharged into the WC pan. The water can be delivered to the WC pan in several different ways depending on the cistern design:

- **By the use of a siphon** – This is the traditional way to flush a WC cistern. The cistern is flushed using siphonic action. The WC flushing handle is connected to the siphon by a link pin. When the WC cistern handle is depressed, the link pin lifts a plunger in the siphon bell, which has a large thin plastic or rubber diaphragm at the end of it. The diaphragm lifts a column of water up and over the top of the siphon to begin the siphonic action. There are many different styles and sizes of WC siphon available and the correct one must be chosen depending on the cistern size. Some
siphons allow different flushing volumes to be set by adjusting the height at which air is let into the siphon bell to stop the siphonic action.

- **By the use of a dual flush valve** – These can be operated by pressing a button on the top of the WC cistern, or remotely by air blown through a tube when the button is depressed, or by remote infrared sensor linked to a solenoid valve for concealed cisterns. They work by simply opening up a valve when the button is activated; this allows water to flow by gravity to the pan. Siphonic action is not required. Flush valves have a 6-litre and a 4-litre flush action. They also have an integrated overflow that allows water to flow straight to the WC pan should the float-operated valve begin to overflow, so a separate overflow pipe is not required.

- **By the use of a drop valve** – This is also known as a flap valve. It is a very simple valve that allows water to flow by gravity to the pan. In the closed position, it is the weight of the water that makes a watertight seal. When the WC handle is depressed, a link pin simply lifts the valve up. These are not dual flow and will only flush as long as the handle is pressed down. Most flap valves have an integral overflow.

**KEY POINT**

Prior to 1986, the flush volume for a WC cistern was 9 litres. This was lowered in the Model Water By-laws of 1986 to 7.5 litres. Today, the Water Supply (Water Fittings) Regulations 1999 restrict the flushing volumes of new WC cisterns to 6 litres for a long flush and 4 litres for a short flush, but older WC pans will not flush with such a low water volume, so 9- and 7.5-litre cisterns are still available for the replacement market.
The water in the cistern is controlled using a float-operated valve conforming to BS 1212 parts 2, 3 and 4. The cistern must also have a service valve fitted as close to the cistern as possible. A separate overflow must be installed with WC cisterns that do not have an integral overflow, and this must discharge safely in a conspicuous position, usually outside the building. Integral overflows discharge directly into the WC pan via the cistern.

WC cisterns can be made from a variety of materials, including vitreous china, plastic and hard rubber, but other materials such as cast iron and lead-lined wood have also been used in the past.

WASH HAND BASINS
There are literally hundreds of different styles of wash hand basin and many of these also come in various sizes and tap arrangements. Corner wash basins are also available. Wash basins should be installed with approximately 800mm from the floor to the front lip of the basin. They can be divided into four basic types:

- **Wall-hung wash basin** – This wash basin is mounted on wall-fixed brackets or bolted directly to the wall. There are several different types of mounting brackets, including towel rail-type or concealed, depending on the wash basin style. The mounting wall must be able to take the weight of the wash basin. If there is any doubt, either a centre leg or a pair of legs should be used.

- **Pedestal wash basin** – There are two different types. A pedestal wash basin is fixed to the wall but relies on the pedestal for its main support. The pedestal is designed to hide the pipework. Semi-pedestal wash basins are becoming increasingly popular. The pedestal does not carry the weight of the basin as it does not reach the floor and it is designed to hide the associated pipework.

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**SUGGESTED ACTIVITY...**
Service valves and float-operated valves were covered in detail in the cold water Chapter. Why not check out these chapters and refresh your learning on this important subject?
- **Counter-top wash basin** –
  - **Counter-top style** – also known as an inset wash basin. It sits snugly in a worktop surface.
  - **Semi-counter-top style** – also known as a semi-recessed basin. It sits half on and half off a work surface.
  - **Under-counter-top style** – as the name suggests, this type is mounted under a work surface. The work surface is usually marble, agglomerate marble or granite.

- **Vessel wash basin** – This type of basin is designed to be supported by a mounting surface such as a worktop or cabinet.

Wash basins can be made from a variety of materials, including vitreous china, stainless steel and porcelain enamelled pressed steel.
### Tap hole and waste arrangements for wash basins

There are four main tap hole arrangements for wash basins:

<table>
<thead>
<tr>
<th>Arrangement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One tap hole basin with monobloc mixer tap</strong></td>
<td>Specifically designed for use with a monobloc mixer tap.</td>
</tr>
<tr>
<td><strong>Two tap hole basin with hot and cold taps</strong></td>
<td>The traditional tap hole arrangement for use with hot and cold ½-in BSP pillar taps.</td>
</tr>
<tr>
<td><strong>Three tap hole basin with remote mixer tap</strong></td>
<td>This is a little-used tap arrangement where the tap bodies are fitted below the basin with just the wheel heads showing. The spout and the tap bodies are concealed below the wash basin.</td>
</tr>
<tr>
<td><strong>No tap hole basin with wall-mounted taps</strong></td>
<td>Becoming more popular for bespoke bathrooms, these use wall-mounted designer bib taps with concealed pipework.</td>
</tr>
</tbody>
</table>

Wash basins are manufactured with an integral overflow for use with a 1¼-in slotted waste for connection to a 32mm waste trap. There are two basic waste types available:

- **Slotted waste, plug and chain** – The old-fashioned method of providing a waste stopper. The slots in the waste are to allow water that has flowed down the integral overflow to find its way safely down to the trap. These are usually made in to the basin with silicone sealant with a plastic poly-washer inserted between the securing nut and the basin. Care should be taken when using gold-plated fittings and silicone sealant as some sealants can discolor the gold plating.
- **Pop-up waste** – These provide a handle, typically designed as part of the tap, which, when pushed down, pops the waste plug up. They tend to have specific sealing washers to seal the waste into the basin. Pop up wastes can also be a spring-loaded type which opens via a spring when the waste plug itself is depressed.

- **BIDETS**

  Very similar in design to a WC pan, the bidet is often described as a sit-on wash basin. The bidet is a hygienic method of ensuring personal cleansing, especially after using the WC. An important secondary use is that of a footbath. There are two types:

  - **The over-rim bidet** – The most common bidet type, installed in the same way as a wash basin. It is available with one or two tap holes, depending on the bidet design, and can be fitted with a variety of taps including monobloc mixers, pillar taps and hand spray-type mixers with a hose connection.

  - **The ascending spray bidet** – Very rarely seen in the UK, the ascending spray bidet uses a special tap arrangement to discharge water upwards from inside the bowl of the bidet in a spray similar to a small shower head. Special installation arrangements exist for this appliance because of the risk of contamination of water by backflow through the spray head. It must not be installed on mains pressure systems and the Water Regulations should be consulted for all installations of this type of appliance.
Bidets are usually made from vitreous china. Styles include floor-mounted, back-to-wall and wall-hung types.

**SUGGESTED ACTIVITY...**
The installation of ascending spray bidets was covered in detail in the hot water Chapter. Take a look back at that chapter to make sure you are clear on this important topic.

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**BATHS**
Baths are manufactured to BS 4305 (EN 198) and can be supplied manufactured from the following materials:

- **Reinforced cast acrylic sheet** – This is the most common material for baths. Some acrylic baths require reinforcement in the form of glass-reinforced polyester, and all types require a steel tubular cradle, a top frame and a base board.

- **Porcelain-enamelled steel** – These tend to be used in commercial situations such as hotels, hostels etc or in housing association and Local Authority housing where durability is important.

In Europe, pressed steel baths are more common than acrylic.
- **Porcelain-enamelled cast iron** – These have a much lower share of the market and tend to be used for the more traditional designs such as roll-top freestanding and rectangular shapes.

Other materials are also available, such as resin-bonded cementitious slurry, known as resinstone, and gel-coated reinforced polyester, but these are generally used in specialist and niche markets.

Each material has its own unique characteristics, which influence the bath design. Baths can be manufactured in a wide variety of styles and designs, including:

- **Standard baths** – These are rectangular-shaped and come in many size and design options. They are usually fitted with a front panel and/or end panels as required.

- **Corner baths** – These fit into the corner of the bathroom. They require a curved bath panel, which is easily cut and trimmed to specific installation requirements.

- **Off-set corner baths** – These are similar to a standard corner bath but they have sides of unequal length. This design utilises the space available while optimising the bathing space. They are available left- or right-handed, depending on the installation requirements.

- **Freestanding baths** – These are designed to stand on their own feet and are usually not fitted against a supporting wall. A range of styles is available, from traditional roll-top and claw-and-ball styles to more contemporary designs.
Double-ended baths – These are usually rectangular in shape but they have two non-tap ends and side-mounted taps. They are designed with two people in mind.

Tapered baths – These are designed where space is at a premium. They are wider at one end and are usually fitted with a shower at the wider end.

Shower/baths – Again, these are usually wider at one end to maximise the space available for showering.

Baths for the disabled – Many baths on the market have been modified for disabled access. Modifications include doors that allow the user to walk in, or chairlifts to lower the user in and out.

Spa baths and whirlpools – These will be covered later in this chapter.

The most common sizes range from 1600mm to 1800mm in length and from 700mm to 800mm in width. The most popular shapes require a front bath panel and, very often, end panels to hide the frame, the cradle and the plumbing.

Tap hole and waste arrangements for baths

Tap holes for baths come supplied in one of three ways:

No tap hole – This type of bath must be drilled so the taps can be installed in the position of the customer’s choice, or can be used with wall-mounted taps.

Two tap hole – This is the standard arrangement. The taps may be on either the end of the bath or the side.

Three tap hole – For remote-type taps (one hole for the spout and two for the taps).

Waste connections for baths can be made by:

The banjo-type bath waste fitting – This uses a long, threaded waste fitting with slots on opposite sides near the top. The waste from the overflow comes via a flexible pipe connected by a banjo connection. This is assembled over the waste fitting and is held in place on the underside of the bath by a large 1½-in BSP nut fitted to